

WHAT IS CLAIMED IS:

1. A gene examining apparatus utilizing a computer, the apparatus comprising:

5 (1) DNA microarrays in each of which a large number of fine liquid accommodating sections are two-dimensionally arranged so that openings of the fine liquid accommodating sections are located on the same plane, in which each of the liquid accommodating sections can three-dimensionally accommodate a liquid,  
10 and in which hybridization reaction occurs in the liquid accommodating section between a target nucleic acid already labeled with an optical marker substance and the nucleic acid probe; and

(2) a microscope comprising a stage supporting the  
15 DNA microarrays set forth in (1), a temperature regulating section that regulates the temperature of each DNA microarray, and imaging means for picking up an image of an optical signal from the DNA microarray.

2. The gene examining apparatus utilizing a  
20 computer according to claim 1, wherein the DNA microarray comprises a porous film having a branching channel, and the nucleic acid probe is immobilized on an inner wall of the channel in the porous film.

3. The gene examining apparatus utilizing a  
25 computer according to claim 1, further comprising:

(a) an input section which is used by an operator to input information to a computer integrally

controlling the gene examining apparatus; and

(b) a display section which displays an image picked up by the imaging means.

4. The gene examining apparatus utilizing a  
5 computer according to claim 1, further comprising an image processing section which determines the intensity of an optical signal for each of the probe spots on the basis of the image picked up by the imaging means.

5. A method of examining a gene using the  
10 apparatus according to claim 1, the method comprising;

(1) amplifying a nucleic acid extracted from a tissue or a cell obtained from a subject and adding an optical marker substance as a marker substance to afford a labeled nucleic acid;

15 (2) adding the labeled nucleic acid obtained in (1) to a DNA microarray comprising a desired nucleic acid probe;

(3) using the DNA microarray in (2) to cause hybridization reaction under desired conditions;

20 (4) measuring the intensity of an optical signal from the optical marker substance in the DNA microarray obtained in (3); and

(5) on the basis of the intensity of the optical signal obtained in (4), determining the amount of an  
25 expressed gene and/or whether or not any mutated gene is present, to obtain results of gene examinations.

6. A method of examining a gene using the

apparatus according to claim 1, the method comprising;

(1) amplifying a nucleic acid extracted from a tissue or a cell obtained from a subject and adding an optical marker substance as a marker substance to afford a labeled nucleic acid;

(2) adding the labeled nucleic acid obtained in (1) to a DNA microarray comprising a desired nucleic acid probe;

(3) using the DNA microarray in (2) to cause hybridization reaction under desired conditions;

(4) after the reaction in (3) has been finished, collecting a solution contained in the DNA microarray, at the bottom of the array;

(5) measuring the intensity of an optical signal from the optical marker substance in the DNA microarray obtained in (3);

(6) agitating again the liquid collected at the bottom of the array in (4);

(7) using the DNA microarray in (6) to repeat hybridization reaction under desired conditions as required;

(8) measuring the intensity of an optical signal from the DNA microarray obtained in (6); and

(9) on the basis of the intensities of the optical signals obtained in (4) and (8), determining the amount of an expressed gene and/or whether or not any mutated gene is present, to obtain results of gene

examinations.

7. The method according to claim 5, further comprising comparing information obtained by determining, on the basis of the intensity of the optical signal obtained in (4), the amount of an expressed gene and/or whether or not any mutated gene is present, with well-known information disclosed in a database and/or information obtained from a standard sample, thereby obtaining the results of gene examinations.

8. The method according to claim 6, wherein operations from (5) to (8) are repeated twice or more.

9. A gene examining apparatus utilizing a computer, the apparatus comprising:

- (1) DNA microarrays in each of which a large number of fine liquid accommodating sections are two-dimensionally arranged so that openings of the fine liquid accommodating sections are located on the same plane, in which each of the liquid accommodating sections can three-dimensionally accommodate a liquid, and in which hybridization reaction occurs in the liquid accommodating section between a target nucleic acid already labeled with an optical marker substance and the nucleic acid probe;
- (2) a microscope comprising a stage supporting the DNA microarrays set forth in (1), a temperature regulating section that regulates the temperature of

each DNA microarray, and imaging means for picking up an image of an optical signal from the DNA microarray; and

5 (3) fluid transporting section connected to the DNA microarray arranged on the stage of the microscope set forth in (2), to move a fluid into and out of the DNA microarray.

10 10. The apparatus utilizing a computer according to claim 9, wherein the DNA microarray comprises a porous film having a branching channel, and the nucleic acid probe is immobilized on an inner wall of the channel in the porous film.

11. The gene examining apparatus utilizing a computer according to claim 9, further comprising:

15 (a) an input section which is used by an operator to input information to a computer integrally controlling the gene examining apparatus; and

(b) a display section which displays an image picked up by the imaging means.

20 12. The gene examining apparatus utilizing a computer according to claim 9, further comprising an image processing section which determines the intensity of an optical signal for each of the probe spots on the basis of the image picked up by the imaging means.

25 13. A method of examining a gene using the apparatus according to claim 9, the method comprising;

(1) amplifying a nucleic acid extracted from a

tissue or a cell obtained from a subject and adding an optical marker substance as a marker substance to afford a labeled nucleic acid;

5       (2) adding the labeled nucleic acid obtained in (1) to a DNA microarray comprising a desired nucleic acid probe;

      (3) using the DNA microarray in (2) to cause hybridization reaction under desired conditions;

10       (4) measuring the intensity of an optical signal from the optical marker substance in the DNA microarray obtained in (3); and

      (5) on the basis of the intensity of the optical signal obtained in (4), determining the amount of an expressed gene and/or whether or not any mutated gene is present, to obtain results of gene examinations.

14. A method of examining a gene using the apparatus according to claim 9, the method comprising;

20       (1) amplifying a nucleic acid extracted from a tissue or a cell obtained from a subject and adding an optical marker substance as a marker substance to afford a labeled nucleic acid;

      (2) adding the labeled nucleic acid obtained in (1) to a DNA microarray comprising a desired nucleic acid probe;

25       (3) using the DNA microarray in (2) to cause hybridization reaction under desired conditions;

      (4) after the reaction in (3) has been finished,

collecting a solution contained in the DNA microarray,  
at the bottom of the array;

5 (5) measuring the intensity of an optical signal  
from the optical marker substance in the DNA microarray  
obtained in (3);

(6) agitating again the liquid collected at the  
bottom of the array in (4);

10 (7) using the DNA microarray in (6) to repeat  
hybridization reaction under desired conditions as  
required;

(8) measuring the intensity of an optical signal  
from the DNA microarray obtained in (3); and

15 (9) on the basis of the intensities of the optical  
signals obtained in (4) and (8), determining the amount  
of an expressed gene and/or whether or not any mutated  
gene is present, to obtain results of gene  
examinations.

20 15. The method according to claim 13, further  
comprising comparing information obtained by  
determining, on the basis of the intensity of the  
optical signal obtained in (4), the amount of an  
expressed gene and/or whether or not any mutated gene  
is present, with well-known information disclosed in a  
database and/or information obtained from a standard  
25 sample, thereby obtaining the results of gene  
examinations.

16. The method according to claim 14, wherein

operations from (5) to (8) are repeated twice or more.

17. A gene examining apparatus utilizing a computer, the apparatus comprising:

- 5 (1) DNA microarrays in each of which a large number of fine liquid accommodating sections are two-dimensionally arranged so that openings of the fine liquid accommodating sections are located on the same plane, in which each of the liquid accommodating sections can three-dimensionally accommodate a liquid,  
10 and in which hybridization reaction occurs in the liquid accommodating section between a target nucleic acid already labeled with an optical marker substance and the nucleic acid probe;
- 15 (2) a microscope comprising a stage supporting the DNA microarrays set forth in (1), a temperature regulating section that regulates the temperature of each DNA microarray, and imaging means for picking up an image of an optical signal from the DNA microarray;
- 20 (3) fluid transporting section connected to the DNA microarray arranged on the stage of the microscope set forth in (2), to move a fluid into and out of the DNA microarray;
- (4) a storage section which stores:
  - 25 (a) programs indicating procedures and conditions for causing reaction in the DNA microarray in (1) while controlling all sections of the apparatus including the temperature regulating section in (2) and



the liquid transporting section in (3) and then processing results obtained, and

(b) a score table indicating the type of the nucleic acid probe in (1) in association with coordinates of the nucleic acid probe in the DNA microarray;

(5) a main control section which controls the sections in (2) and (3) to operate the apparatus for the DNA microarray in (1) in accordance with a program stored in the storage section in (4), thus integrally controlling the whole apparatus;

(6) an image processing section which operates after the reaction based on the control by the main control section in (5), to process the image picked up by the imaging means set forth in (2) to determine the intensity of an optical signal for each of the probe spots, in accordance with a program contained in the storage section in (4); and

(7) an output section which searches the score table stored in the storage section in (4) to output, as determination results of gene examinations, data corresponding to the intensity of an optical signal from the coordinates determined by the image processing section in (6).

18. The apparatus utilizing a computer according to claim 17, wherein the DNA microarray comprises a porous film having a branching channel, and the nucleic

acid probe is immobilized on an inner wall of the channel in the porous film.

19. A method of examining a gene using the apparatus according to claim 17, the method comprising;

5       (1) amplifying a nucleic acid extracted from a tissue or a cell obtained from a subject and adding an optical marker substance as a marker substance to afford a labeled nucleic acid;

10       (2) adding the labeled nucleic acid obtained in (1) to a DNA microarray comprising a desired nucleic acid probe;

      (3) using the DNA microarray in (2) to cause hybridization reaction under desired conditions;

15       (4) measuring the intensity of an optical signal from the optical marker substance in the DNA microarray obtained in (3); and

20       (5) on the basis of the intensity of the optical signal obtained in (4), determining the amount of an expressed gene and/or whether or not any mutated gene is present, to obtain results of gene examinations.

20. A method of examining a gene using the apparatus according to claim 17, the method comprising;

25       (1) amplifying a nucleic acid extracted from a tissue or a cell obtained from a subject and adding an optical marker substance as a marker substance to afford a labeled nucleic acid;

      (2) adding the labeled nucleic acid obtained in

(1) to a DNA microarray comprising a desired nucleic acid probe;

(3) using the DNA microarray in (2) to cause hybridization reaction under desired conditions;

5 (4) after the reaction in (3) has been finished, collecting a solution contained in the DNA microarray, at the bottom of the array;

(5) measuring the intensity of an optical signal from the optical marker substance in the DNA microarray  
10 obtained in (3);

(6) agitating again the liquid collected at the bottom of the array in (4);

(7) using the DNA microarray in (6) to repeat hybridization reaction under desired conditions as  
15 required;

(8) measuring the intensity of an optical signal from the DNA microarray obtained in (3); and

(9) on the basis of the intensities of the optical signals obtained in (4) and (8), determining the amount  
20 of an expressed gene and/or whether or not any mutated gene is present, to obtain results of gene examinations.

21. The method according to claim 19, further comprising comparing information obtained by  
25 determining, on the basis of the intensity of the optical signal obtained in (4), the amount of an expressed gene and/or whether or not any mutated gene

is present, with well-known information disclosed in a database and/or information obtained from a standard sample, thereby obtaining the results of gene examinations.

- 5           22. The method according to claim 20, wherein operations from (5) to (8) are repeated twice or more.